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**Improvements to travelling irrigators for water and effluent applications**

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## ABSTRACT

A self-propelled irrigator supplied with water from a flexible irrigation hose has a winch drum driven by a rotating spray boom to wind up an anchored cable and draw the irrigator toward the anchor point. A gear train connecting the winch drum and boom includes a driven gear fixed to the winch drum and a driving gear fixed to the boom, both connected by an idler gear assmebly. The winch drum is axially moveable to disconnect it from the gear train at the end of its travel and for freewheeling. The winch drum may be in two sections having different diameters, preferably of conical section, to provide increased torque as the hose drag increases.

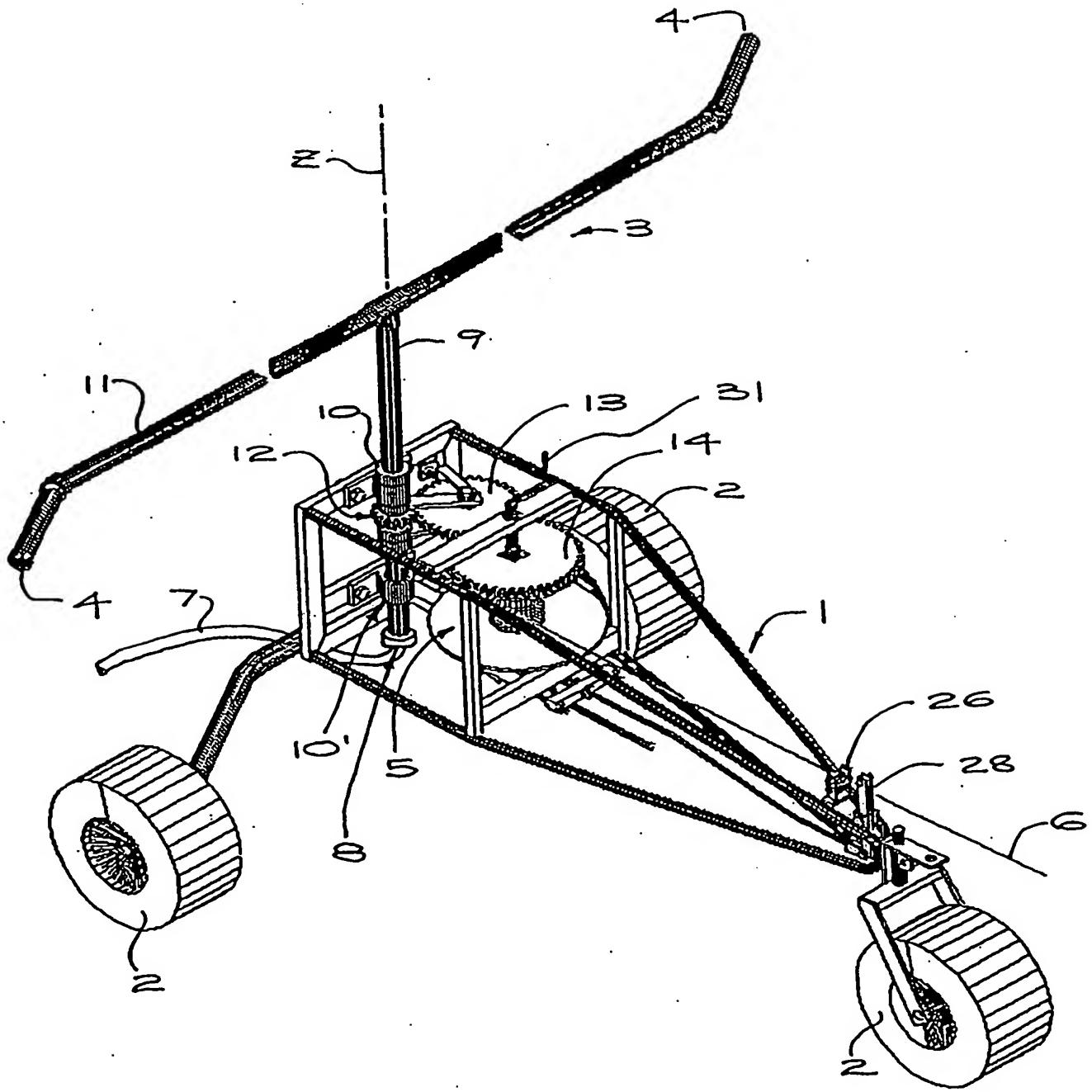


FIG. 1

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**COMPLETE SPECIFICATION**

**FOR A STANDARD PATENT**

**ORIGINAL**

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Title: **IMPROVEMENTS TO TRAVELLING IRRIGATORS FOR WATER AND EFFLUENT APPLICATIONS**

Associated Provisional Applications: No(s).:

The following statement is a full description of this invention, including the best method of performing it known to me/us:-

TITLE: IMPROVEMENTS TO TRAVELLING IRRIGATORS FOR WATER AND EFFLUENT APPLICATIONS

## TECHNICAL FIELD

The present invention relates generally to travelling sprinkler irrigation, and more particularly to linear-move self-propelled irrigators.

## BACKGROUND ART

Linear-move travelling sprinkler systems consisting of a wheeled cart with a large sprinkler (more commonly called a "gun"), a winch drum, and an irrigation hose are well known. In operation the wheeled cart is pulled by the winch drum to winch in either a cable or a hard irrigation hose. The gun cart with the hose attached, is pulled out some distance from the winch. A pump is then started, which provides water to the gun and the winch then begins to slowly winch in the gun cart as the sprinkler operates.

There are many variants of linear travelling irrigators and several drive or winch-in power systems are used. A separate power source, for example a small petrol engine, may be mounted on the winch. In self-propelled water pressure driven irrigators, such as a turbine drive or bellows-type system a portion (or all) of the irrigation water flows through the turbine or bellows on the way to power the winch. A drawback of irrigators using these types of drive is that they are costly machines and therefore not economically viable for irregular use, such as for spreading effluent.

Self-propelled boom type irrigators, such as that described in New Zealand patent No. 210739/210791 employ a boom rotated by water jet reaction to drive a winch engaging an

anchored cable, and have found application where lower cost is a consideration. However the known systems still have a number of disadvantages, they have a low efficiency and operate at a minimum application rate which is too high for many effluent applications. These systems also remain relatively costly to manufacture and operate, having a number of expensive parts requiring regular maintenance and adjustment. Furthermore, they often lack provision for varying the application rate, or where this is provided it is difficult to perform.

The reciprocating movement of a cam or impact member fixed to the rotating spray boom is commonly used to drive the winch through a reverse rotation preventing ratchet and pawl mechanism. Mechanical problems and inertia, however, limit the use of this type of drive to lower travel speeds.

In operation a cable driver travelling irrigator must draw the irrigation hose along the ground and the longer the length required to be drawn along the higher the torque requirement for the winch. The approach taken in travelling irrigators has been to provide a constant ratio between the boom rotation speed and the winch drive, providing a constant application rate. However this fixed ratio and therefore fixed winch torque limits either the maximum travelling speed of the irrigator or the maximum length of hose that the irrigator may draw along.

All references, including any patents or patent applications cited in this specification are hereby incorporated by reference. No admission is made that any reference constitutes prior art. The discussion of the references states what their authors assert, and the applicants reserve the right to challenge the accuracy and pertinency of the cited documents. It will be

clearly understood that, although a number of prior art publications are referred to herein, this reference does not constitute an admission that any of these documents form part of the common general knowledge in the art, in New Zealand or in any other country.

It is an object of the present invention to address the foregoing problems or at least to provide the public with a useful choice.

Further aspects and advantages of the present invention will become apparent from the ensuing description which is given by way of example only.

## DISCLOSURE OF INVENTION

According to one aspect of the present invention there is provided a linear-move self-propelled irrigator including:

an inlet adapted to be connected to a flexible irrigation hose which in operation is drawn along by the irrigator;

a rotor rotatable about a vertical axis by the reaction to a liquid jet produced by one or more spray nozzles in communication with the inlet;

a winch drum driven by the rotor for winding up a cable to draw the irrigator along, the free end of the cable being securable to an anchor point in the area to be irrigated, and

a gear train drivingly connecting the winch drum to the rotor, wherein the gear train includes a driving gear fixed to the rotor and a driven gear fixed to the winch drum, the driving and driven gears being connected by an idler gear assembly.

In the preferred embodiment the rotor includes a boom extending substantially symmetrically either side of the vertical axis with one spray nozzle fixed to each end thereof. Alternatively the rotor, for example, may be part of a sprinkler or irrigation gun.

The rotor preferably, includes a stanchion aligned with the vertical axis and connected to the boom, wherein both the stanchion and boom are in the form of pipes providing a liquid passageway from the inlet to the nozzles.

Preferably, the winch drum is axisymmetrical and coaxial with the driven gear.

Preferably, the winch drum is rotated about a vertical axis and the axes of the driving gear, driven gear and idler gear assembly are also vertical. Optionally, the winch drum rotates about a horizontal or inclined axis. The idler gear assembly includes at least one idler gear, and preferably two coaxial idler gears are included; one engaging the driven gear, the other the driving gear.

According to another aspect of the present invention there is provided an irrigator substantially as described above wherein the driven gear is readily manually replaceable to vary the travel speed of the irrigator. For example, the driven gear may have a square central aperture to engage a square shaft section fixed concentrically on the winch drum, the driven gear being axially fixed by a threaded fastener.

According to another aspect of the present invention there is provided an irrigator substantially as described above wherein a shoulder divides the surface of the winch drum

into at least two sections having different diameters, one section including the smallest diameter surface of the winch drum ("the smaller side") and one including the largest diameter surface of the winch drum ("the larger side").

In use, the hose required is at least half the length of the cable and the cable is fully extended and anchored. One end of the hose is connected to the irrigator, the other to an intermediate water supply point. In the preferred embodiment the surface of the winch drum includes two sections and cable is first wound onto the larger side of the winch drum. As the length of hose being drawn by the irrigator increases the cable fills the larger side and drops over the shoulder onto the smaller side, in this manner the winch drum is able to provide a greater torque to overcome the increasing hose drag.

The shoulder is preferably formed by a radially extending disc dividing the surface of the winch drum in two. Most preferably the smaller and larger sides are frustroconical, extending between the disc and upper and lower end plates respectively. Optionally, the smaller and larger sides may be cylindrical or of other shape having a circular section.

According to another aspect of the present invention there is provided an irrigator substantially as described above, further including disconnect means for moving the gears relative to one another to disconnect the driving gear from the driven gear.

Preferably, the disconnect means includes means for axially moving the driven gear to disengage it from the idler gear. When disconnected in this manner the winch drum freewheels, allowing the cable to be unwound freely or wound up manually. Alternatively,

the disconnect means may move the driven gear radially or obliquely to disengage it from the idler gear.

According to another aspect of the present invention there is provided an irrigator substantially as described above, further including a cut-out device to activate the disconnect means and thereby stop the irrigator as it approaches the cable anchor, the cut-out device including:

a fixture on the cable near the anchored end;

a pivotably mounted yoke through which the cable is slidably guided, and

a mechanism connecting the yoke to the driven gear, whereby

as the irrigator approaches the anchored end the fixture engages the yoke and thereby pivots actuating the mechanism to axially move and disconnect the driven gear.

This irrigator is lightweight, effective and efficient in operational use. It may be economically constructed and has an overall simple design which minimizes manufacturing costs and maximizes performance.

**BRIEF DESCRIPTION OF DRAWINGS**

Further aspects of the present invention will become apparent from the following description which is given by way of example only and with reference to the accompanying drawings in which:

Figure 1 is a pictorial view of an irrigator of the present invention;

Figure 2 is partly cut away pictorial view of drive mechanism of the irrigator of Fig.

1;

Figures 3a and 3b are side elevations of the irrigator of Fig. 1 showing the winch drum in engaged and disengaged positions respectively, and

Figure 4 is a side elevation of an alternative winch drum for use in the irrigator of Fig. 1

## BEST MODES FOR CARRYING OUT THE INVENTION

Referring to Fig. 1, a first preferred embodiment of the irrigator according to the invention includes a frame 1 to which is fixed a rotating sprinkler boom 3. The frame 1 also supports the machine on three ground-engaging wheels 2. The boom 3 is rotated by reaction to the irrigating liquid jet expelled from the nozzles 4 and is drivingly connected to a winch drum 5 which draws the irrigator along a linear path by winding up an anchored cable 6.

The irrigation hose 7 is connected by a swivelling gland 8 to the lower end of the boom stanchion 9. The stanchion 9, having a vertical axis Z, is pivotably fixed in journals 10, 10' and is formed from pipe through which irrigating liquid (water, effluent or the like) flows to the boom arm 11 and thence to each nozzle 4. A drive gear 12 is fixed to the rotating stanchion 9 and transmits power through an idle gear assembly 13 to a driven gear 14 fixed to the winch drum 5.

As shown in Figures 2 and 3a/3b, the idle gear assembly 13 includes an upper gear 15 fixed above a coaxial, smaller diameter gear 16; the upper gear 15 engaging the drive gear 12 and the lower gear 16 engaging the driven gear 14. The idle gear assembly 13 is mounted by means of brackets 17 which are pivotable about axis Z for adjustment, to accommodate

different driven gears 14. All the gears 12, 14, 15, 16 are spur gears fixed on parallel shafts.

At opposing ends of the winch drum 5 are upper and lower endplates 18 and 19, respectively, between which extends a cylindrical drum surface 30. The cable 6 passes through a guide 26 fixed to the frame 1 and is wound onto the winch drum 5.

To provide for selectively engaging the drive to propel the irrigator, the drum 5 is mounted on a central shaft 23 for axial movement between a raised position (Fig. 3a) where the driven gear 14 and lower idler gear 16 are engaged and a lowered position (Fig. 3b), wherein the driven gear 14 and lower idler gear 16 are disengaged and the drum 5 is thereby able to freewheel. In the freewheel position the cable 6 may be fed out or manually wound using the manual winding handle 31.

A cut-out device is provided to disconnect the drive, as described above, to stop the irrigator as it approaches the anchored end of the cable 6. Prior to passing through the guide 26 the cable 6 slides between the arms of a pivotably mounted yoke 28. A lever mechanism 29 connects the yoke 28 to the drum 5 whereby, as the irrigator approaches the anchored end, a clamp 27 fixed on the cable contacts the yoke 28 which is thereby pivoted, actuating the lever mechanism 29 to lower and disengage the drum 5.

An annular groove 33 at the base of the drum 5, between the end plate 19 and a circular flange 24, receives two pins 34 on opposing sides thereof. When the lever mechanism 29 is actuated the pins 24 are pivoted downward, engaging against the flange 24 to lower the drum 5. The lever mechanism 29 includes an actuating rod assembly 40 pivotally connected to the

yoke 28 and to two opposing levers 35 to which the pins 34 are fixed.

A handle 36, fixed about pivot 37, has abutments 38 which bear against a thrust bearing 39 upon which the drum 5 is supported. Operation of the cut-out device as described above pushes the handle 36 down, as shown in Fig. 3b. Whereafter, to re-engage the drive, the handle 36 is raised (to the position illustrated in Fig. 3a) to lift the drum 5 and driven gear 14. It will be understood that, similarly, the drive may be disengaged by lowering handle 36 and allowing the drum 5 and attached driven gear 14 to drop out of engagement.

The driven gear 14 may be readily manually replaced and has a square central aperture 41 to engage a square shaft section 42 fixed concentrically on the winch drum 5, and is axially fixed by a threaded fastener (not shown). Three driven gears 14 are provided with the irrigator, which in combination with the ability to vary the irrigating liquid flow rate (by varying nozzle 4 size and orientation, as well as liquid pressure) allows a range of application rates and travel speeds to be achieved.

Fig. 4 illustrates an alternative drum 5' interchangeable with the drum 5. This drum 5' has a frustro-conical drum surface divided into two frusta 20 and 21 by a radially extending disc 22. In use the cable 6 is first wound onto the frustum 21 having the larger average diameter and the disc 22 provides a shoulder which prevents the cable 6 winding onto the upper frustum 20 until the diameter of the cable coil 25 approaches or exceeds the diameter of the disc 22. When the cable 6 drops over the disc 22 onto the frustum 20 having the smaller average diameter, the winch drum is able to provide a greater torque to overcome the increasing hose drag due to the increasing length of hose being drawn along. In an alternative

embodiment (not shown) a moving cable guide is provided for traversing the drum 5 and controlling the manner in which the cable 6 is wound up.

Aspects of the present invention have been described by way of example only and it should be appreciated that modifications and additions may be made thereto without departing from the scope thereof.

For the purposes of this specification it will be clearly understood that the word "comprising" means "including but not limited to", and that the word "comprises" has a corresponding meaning.

It is to be understood that, if any prior art publication is referred to herein, such reference does not constitute an admission that the publication forms a part of the common general knowledge in the art, in Australia or any other country.

The claims defining the invention are as follows:

1. A linear-move self-propelled irrigator including:

an inlet adapted to be connected to a flexible irrigation hose which in operation is drawn along by the irrigator;

a rotor rotatable about a vertical axis by the reaction to a liquid jet produced by one or more spray nozzles in communication with the inlet;

a winch drum driven by the rotor for winding up a cable to draw the irrigator along, the free end of the cable being securable to an anchor point in the area to be irrigated, and

a gear train drivingly connecting the winch drum to the rotor, wherein the gear train includes a driving gear fixed to the rotor and a driven gear fixed to the winch drum, the driving and driven gears being connected by an idler gear assembly.

2. An irrigator as claimed in claim 1 wherein the rotor includes a boom extending substantially symmetrically either side of the vertical axis with one spray nozzle fixed to each end thereof.

3. An irrigator as claimed in claim 1 or claim 2 wherein the rotor includes a stanchion, aligned with the vertical axis and connected to the boom, wherein both the stanchion and boom are in the form of pipes providing a liquid passageway from the inlet to each nozzle.

4. An irrigator as claimed in any one of the preceding claims wherein the winch drum is axisymmetrical and coaxial with the driven gear.

5. An irrigator as claimed in any one of the preceding claims wherein the winch drum is rotated about a vertical axis and the axes of the driving gear, driven gear and idler gear assembly are also vertical.

6. An irrigator as claimed in any one of the preceding claims wherein the driven gear is readily manually replaceable to vary the travel speed of the irrigator.

7. An irrigator as claimed in any one of the preceding claims wherein a shoulder divides the surface of the winch drum into at least two sections having different diameters, one section including the smallest diameter surface of the winch drum ("the smaller side") and one including the largest diameter surface of the winch drum ("the larger side").

8. An irrigator as claimed in claim 7 wherein the shoulder is formed by a radially extending disc dividing the surface of the winch drum in two.

9. An irrigator as claimed in claim 7 or claim 8 wherein the smaller and larger sides are conical frusta extending between the disc and upper and lower end plates respectively.

10. An irrigator as claimed in any one of the preceding claims further including disconnect means for moving the gears relative to one another to disconnect the driving gear from the driven gear.

11. An irrigator as claimed in claim 10 wherein the disconnect means includes means for axially moving the driven gear to disengage it from the idler gear assembly.

12. An irrigator as claimed in claim 10 or claim 11 further including a cut-out device to activate the disconnect means and thereby stop the irrigator as it approaches the cable anchor, the cut-out device including:

a fixture on the cable near the anchored end;

a pivotably mounted yoke through which the cable is slidably guided, and

a mechanism connecting the yoke to the driven gear whereby as the irrigator approaches the anchored end the fixture engages the yoke and thereby pivots actuating the mechanism to axially move and disconnect the driven gear.

13. An irrigator substantially as hereinbefore described with reference to the accompanying drawings.

Dated this 19th day of December 2001

TECHNIPHARM INTERNATIONAL LTD
By Its Patent Attorneys

GRIFFITH HACK
Fellows Institute of Patent and
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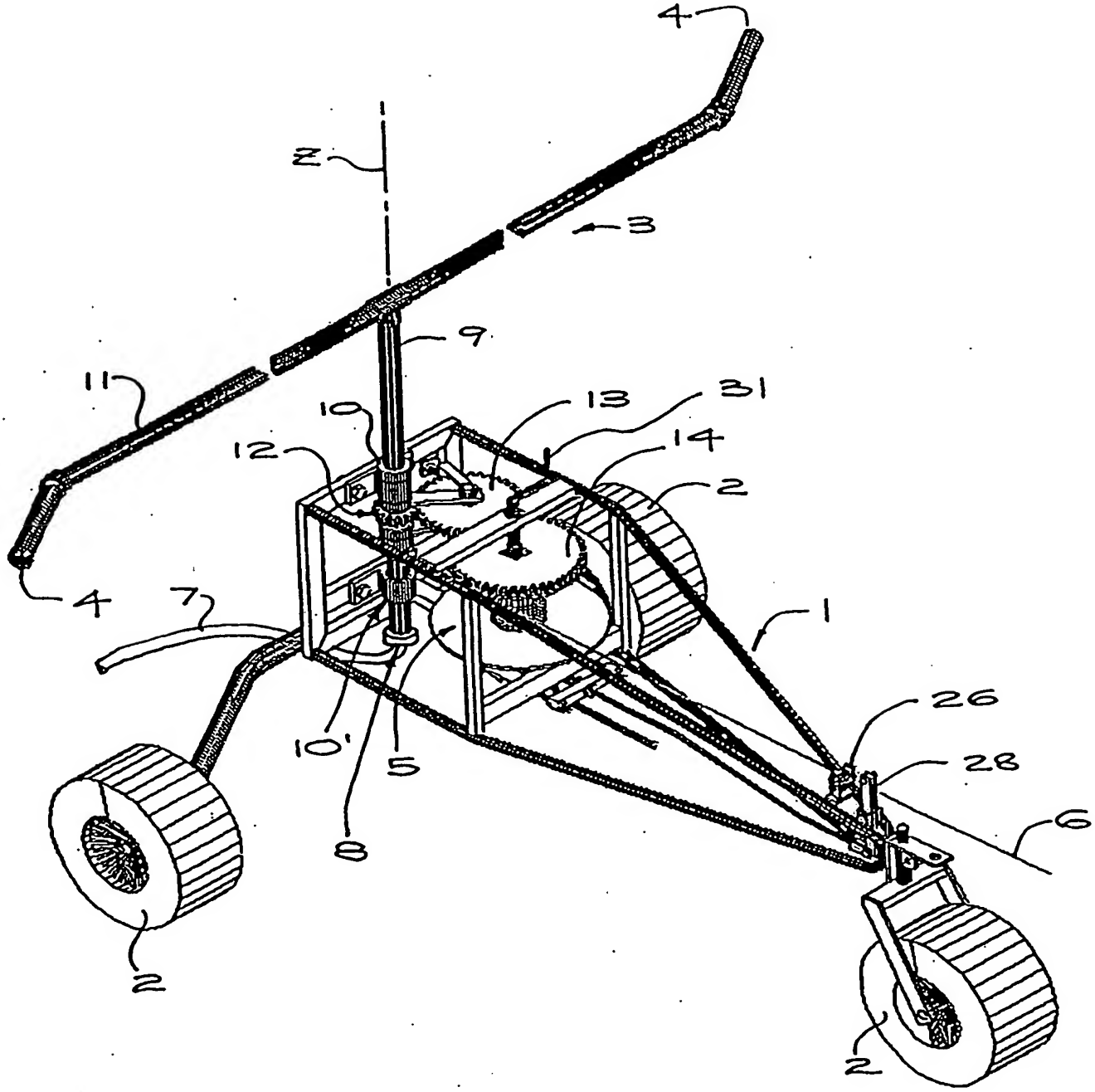


FIG. 1

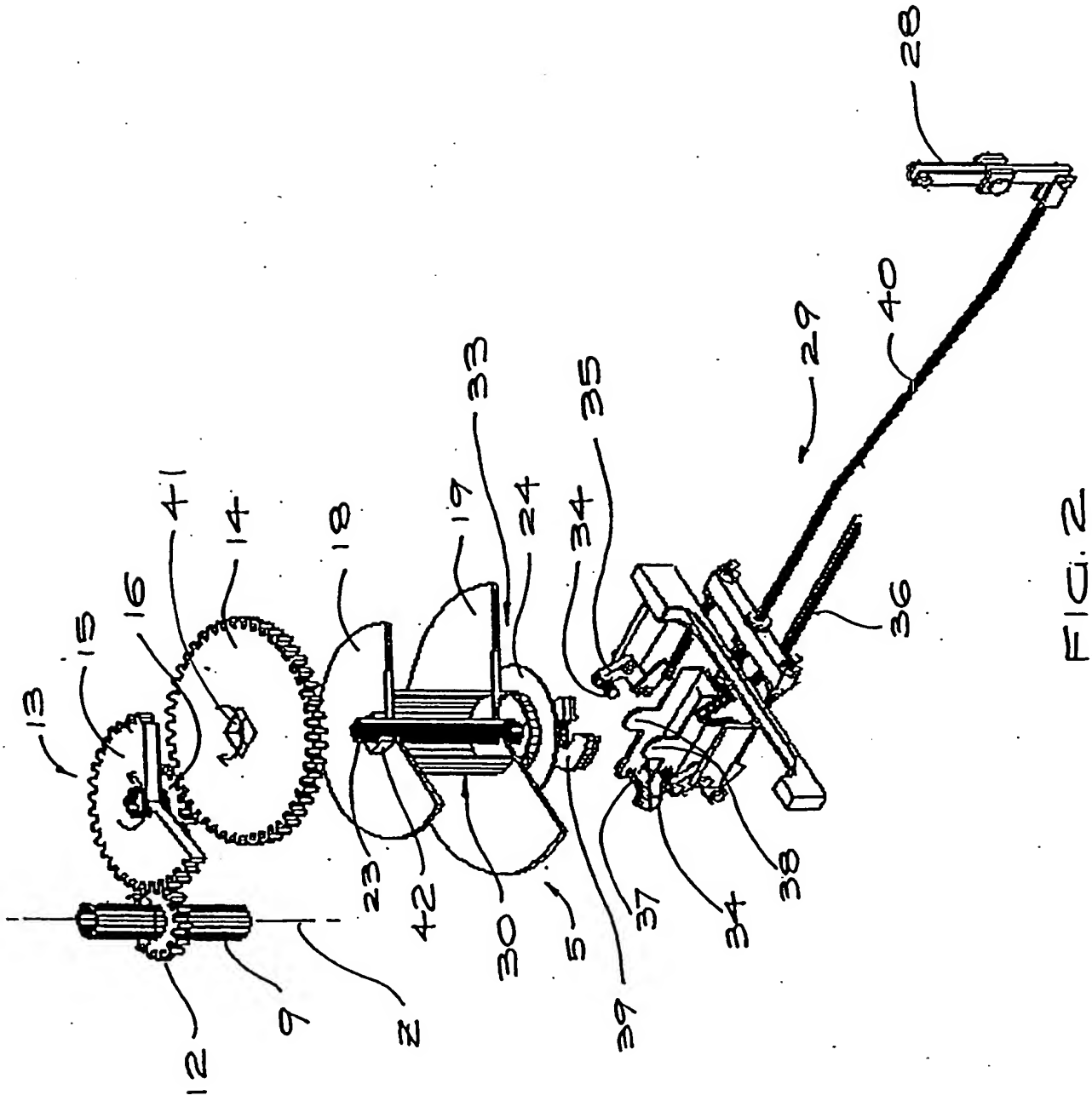


FIG. 2

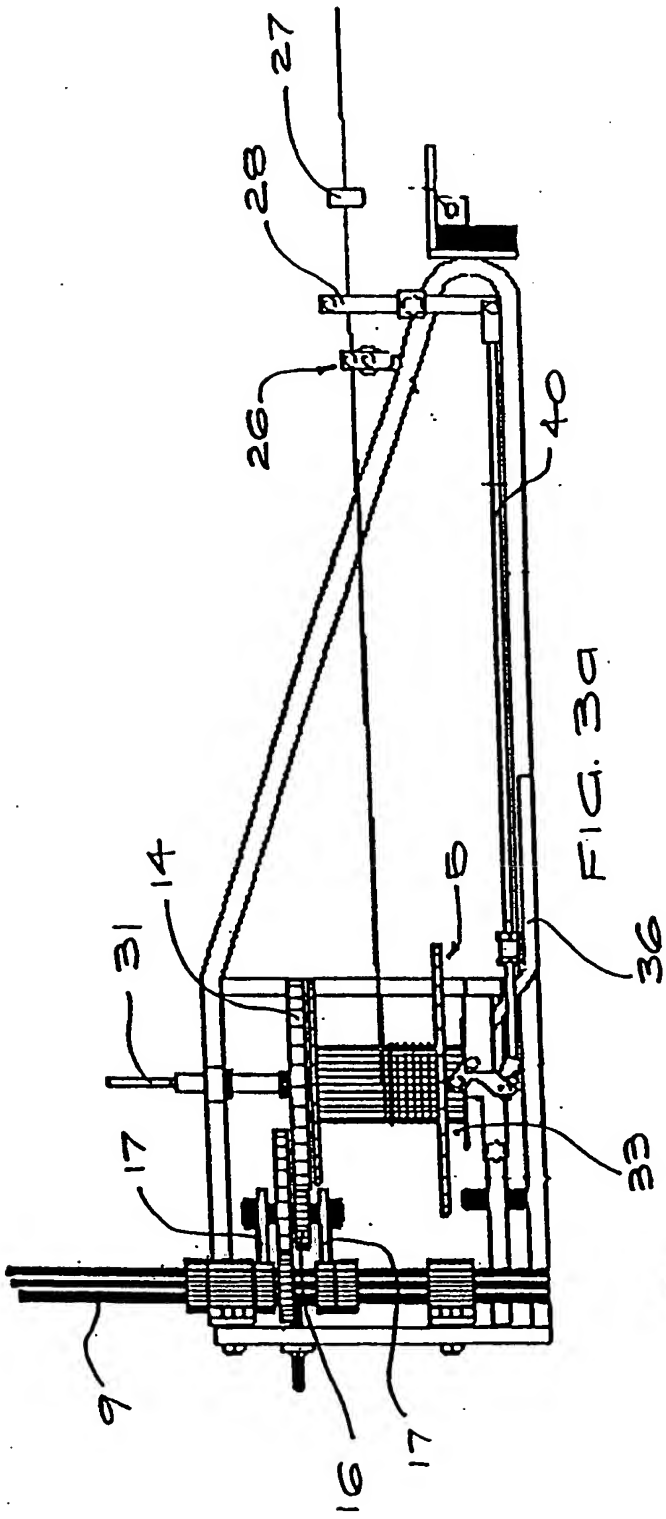


FIG. 3a

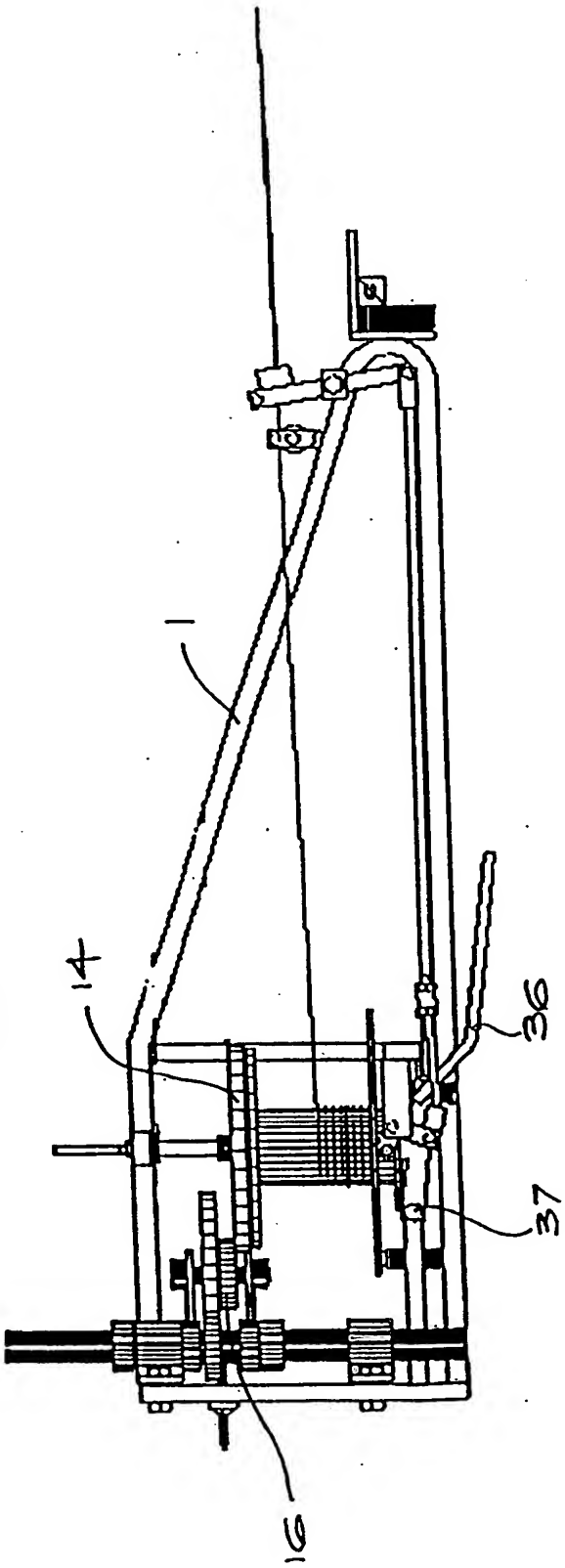


FIG. 3b

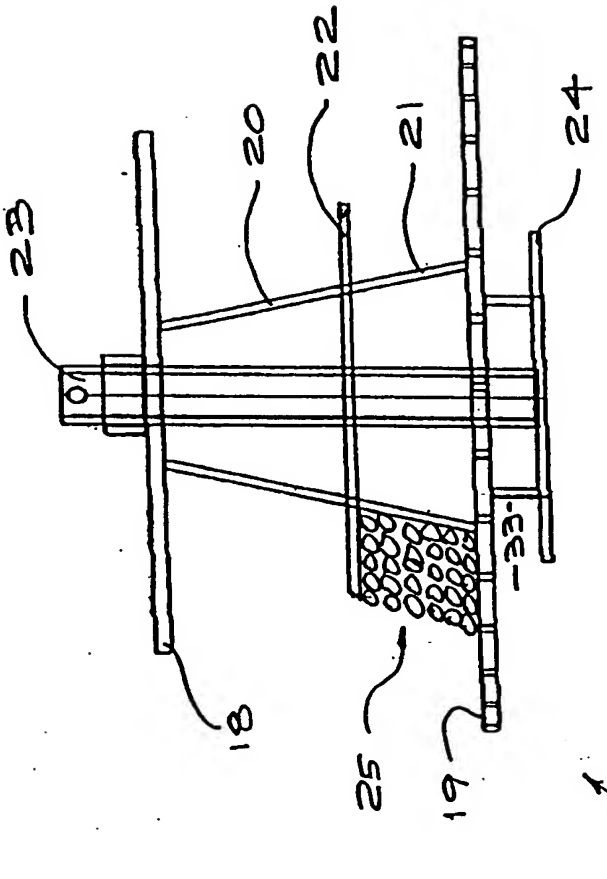


FIG. 4